VINYLIDENE CHLORIDE

Vinylidene chloride is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993 under AB 2728.

CAS Registry Number: 75-35-4 $H_2C=CCl_2$

Molecular Formula: $C_2H_2Cl_2$

Vinylidene chloride is a colorless, volatile liquid that has a mild, sweet odor resembling that of chloroform. It is soluble in organic solvents and practically insoluble in water. At temperatures above 0 °C and especially in the presence of oxygen and other suitable catalysts, vinylidene chloride polymerizes to a plastic. Uncontrolled polymerization may lead to explosive reaction products with oxygen or ozone (Merck 1983).

Physical Properties of Vinylidene Chloride

Synonyms: 1,1-dichloroethene; 1,1-dichloroethylene; asym-dichloroethylene

Molecular Weight:	96.95
Boiling Point:	31.7 °C
Melting Point:	-122.5 °C
Flash Point:	-15 °C (0 °F) (open cup)
Vapor Density:	3.25 (air = 1)
Density/Specific Gravity:	1.2129 at 20/4 °C (water = 1)
Vapor Pressure:	591 mm Hg at 25 °C
Log Octanol/Water Partition Coefficient:	2.13
Water Solubility:	0.25 g/100 ml at 25 °C
Henry's Law Constant:	0.0301 atm-m^3/mole
Conversion Factor:	1 ppm = 3.97 mg/m^3

(Howard, 1990; HSDB, 1991; Merck, 1983; Sax, 1987; Sax, 1989; U.S. EPA, 1994a)

SOURCES AND EMISSIONS

A. Sources

Vinylidene chloride is used primarily in the production of copolymers with vinyl chloride or acrylonitrile to form various plastics. It is also used in adhesives and as a component of synthetic fibers. A small percentage of vinylidene chloride is used as a chemical intermediate. Other sources include its formation through the anaerobic biodegradation of trichloroethylene, the

hydrolysis of 1,1,1-trichloroethane and the thermal decomposition of 1,1,1-trichloroethane (HSDB, 1991). Vinylidene chloride is used as a monomer in the manufacture of plastic-wrap type plastics. It is not known if the monomer is released from the finished products (Hodgson and Wooley, 1991).

The primary stationary sources that have reported emissions of vinylidene chloride in California are sanitary services, automobile repair shops, and oil and gas field services (ARB, 1997b).

B. Emissions

The total emissions of vinylidene chloride from stationary sources in California are estimated to be at least 3,000 pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Vinylidene chloride is not known to occur as a natural product (Howard, 1990).

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of vinylidene chloride. However, the United States Environmental Protection Agency (U.S. EPA) has compiled ambient concentration data from several study areas in the United States from 1989-91. Information from these data reported an overall concentration range of <0.12 to <0.40 micrograms per cubic meter ($\mu g/m^3$) (U.S. EPA, 1993a).

INDOOR SOURCES AND CONCENTRATIONS

California data on indoor concentrations of vinylidene chloride are extremely limited. During June of 1990, 125 households in Woodland, California were monitored for a variety of toxic air contaminants (Sheldon et al, 1992). Sampling included vinylidene chloride. However, it was not present at measurable concentrations in any of the samples. The method quantifiable limit was 0.2 $\mu g/m^3$.

Studies conducted outside of California indicate that vinylidene chloride generally is not found indoors, but on occasion may be found at elevated levels. The mean indoor concentration from a National Volatile Organic Compound database is 19.7 parts per billion by volume (ppbv); however, the 25th, 50th, and 75th percentile concentrations were all zero. The limit of detection for this study was 2.6 ppbv (Hodgson and Wooley, 1991).

ATMOSPHERIC PERSISTENCE

Vinylidene chloride exists in the atmosphere in the gas phase. The dominant atmospheric loss process for vinylidene chloride is by reaction with the hydroxyl radical. Based on this reaction, the atmospheric half-life and lifetime of vinylidene chloride is estimated to be 0.9 days and 1.3 days, respectively (Atkinson, 1994). The reaction products are formaldehyde, phosgene, and chlorine atoms (which react to form hydrogen in the atmosphere) (Atkinson, 1995).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of April 1996, vinylidene chloride contributed to a total cancer risk in 1 of the approximately 550 risk assessments reporting a total cancer risk greater than or equal to 1 in 1 million (OEHHA, 1996a). For non-cancer health effects, vinylidene chloride contributed to a total hazard index in 2 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1 (OEHHA, 1996b).

HEALTH EFFECTS

Probable routes of human exposure to vinylidene chloride are inhalation, ingestion, and dermal contact (Sittig, 1991).

Non-Cancer: Exposure to vinylidene chloride may cause irritation to the skin, eyes, nose, throat, and respiratory tract (Sittig, 1991). Vinylidene chloride is a central nervous system depressant. Long-term inhalation exposure to low levels may cause adverse effects on the liver and kidney (HSDB, 1991; U.S. EPA, 1994a).

A chronic non-cancer Reference Exposure Level (REL) of 32 $\mu g/m^3$ is listed in the California Air Pollution Control Officers Association (CAPCOA) Revised 1992 Risk Assessment Guidelines for vinylidene chloride. The toxicological endpoints considered for chronic toxicity are the gastrointestinal system and liver (CAPCOA, 1993). The U.S. EPA is currently reviewing the Reference Concentration (RfC) for vinylidene chloride. The U.S. EPA has established an oral Reference Dose (RfD) of 0.009 milligrams per kilogram per day for vinylidene chloride based on hepatic lesions in rats. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1994a).

No studies were located regarding adverse developmental or reproductive effects of vinylidene chloride in humans. Inhalation studies on pregnant rats showed birth defects in the offspring (U.S. EPA, 1994a).

Cancer: No relationship between the occurrence of cancer in humans and occupational exposure to vinylidene chloride was demonstrated in the few limited studies available. Cancer studies on mice have shown that vinylidene chloride causes an increase in kidney and mammary

tumors. The U.S. EPA has classified vinylidene chloride in Group C: Possible human carcinogen with an inhalation unit risk estimate of 5.0×10^{-5} (microgram per cubic meter)$^{-1}$. The U.S. EPA estimates that if an individual were to breathe air containing vinylidene chloride at 0.02 $\mu g/m^3$ over an entire lifetime, that person would theoretically have no more than a 1 in 1 million increased chance of developing cancer (U.S. EPA, 1994a). The International Agency for Research on Cancer has classified vinylidene chloride in Group 3: Not classifiable (IARC, 1987a).